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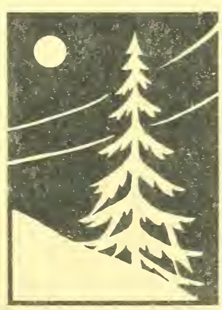

U. S. DEPT. OF AGRICULTURE
FOREST SERVICE
LAKE STATES FOREST EXPERIMENT STATION

F O R E S T   R E S E A R C H   D I G E S T

SPRING 1937

LAKE STATES FOREST EXPERIMENT STATION*

FOREST SERVICE U. S. DEPT. AGR.

NOTES ON EUROPEAN FORESTRY

By Raphael Zon

The manner in which forests are handled is part and parcel of a country's economic and social structure. To understand forestry in Europe it is necessary, therefore, to understand the political, social, and economic background of European countries.

Forest practice in central western Europe is to a large extent the result of three factors: (1) scarcity of raw material, which permits utilization and marketing even of small twigs, (2) presence of a large peasant population willing to work for very small wages from dawn until night, and (3) survival of the feudal system, with its large entailed land ownership of which forests are a part.

It is, therefore, no more possible to transfer European forest practice to America than to transfer the political and economic conditions of Europe to the United States. Just as our institutions have developed from the environment and spirit of our people, so our American forest practice must develop from our own native soil.

Although it is unwise to attempt to transplant European forest practice to our American conditions, a careful study of that practice and of our own past experience points to several

*Maintained in cooperation with the University of Minnesota at University Farm, St. Paul, Minnesota.

fundamental principles common to both. Among them are:

(1) Forests occupy a unique position in the economy of western Europe. They are a definite form of land use, just as agriculture is; and economic and social stability of communities living by the products of the forest, depend upon continuous forest renewal.

(2) Forests, besides their economic significance, are also of national importance because under certain conditions they are the most effective cover against washing of the soil and violent fluctuation in streamflow. For all these reasons, forests assume some of the characteristics of public utilities, which should be either publicly owned or managed under public supervision.

(3) There is a marked tendency in western central Europe for centralized control. This aids in dealing with forest policies and the integration necessary in solving any complex situation.

(4) There is definite recognition in western central Europe of the social responsibility inherent in private ownership of forest lands. This is accepted without discussion, and the forests, therefore, make definite and permanent contributions to social and economic security.

(5) Fundamentally there are only two silvicultural practices: (a) clear cutting and (b) partial cutting. Either of these practices may be effective when forests are managed on the sustained, continuous basis. Clear cutting in the case of conifers must be followed in most cases by artificial planting; in the case of hardwoods by planting or coppice growth. With partial cutting, the dependence is largely upon natural reproduction.

(6) Clear cutting of large contiguous areas is not in the

public interest in privately owned forests which are not managed on a sustained yield basis. Such cuttings, when not followed immediately by planting, invariably revert to forest growth of inferior character or they become brush or waste land.

(7) Intensive forest practice is possible only when complete utilization of all forest products exists; utilization not only of the higher grades of saw logs, but also of wood in such other forms as firewood, fence posts, pulpwood, etc. To develop such complete utilization there must be local markets, and these depend upon prosperous, stable communities near the forest itself. When manufactured into lumber, high grade logs may be shipped to distant points but the less valuable forest products must be utilized locally. Hence the importance of local markets.

(8) Continuous forestry is impossible where the cut exceeds the growth for a long time. Under continuous forest practice, therefore, no mills or other wood-using plants are permitted whose capacity exceeds the growing capacity of the forest. Only under continuous forest practice can stability of the industry, and the economic and social stability of the community depending upon the forest, be assured.

(9) With cellulose an increasingly important material in industrial life, the tendency to grow large amounts of cellulose in the shortest possible time is increasing. With it, however, is a growing demand for specialized products which may not be large in bulk but which, because of high values, are of considerable moment. The growing of logs for veneers or special uses like pianos, violins, or for some specific industrial use like shuttles, points to greater selective management of the forest.

Preservation of the virgin timber from which much of

this specialized production is largely obtained, thus becomes of great economic importance, for it is hardly conceivable that men will be able to grow such large-sized timber on a big scale in the future. Careful utilization of such material is, therefore, very essential.

(10) In the field of planting by artificial means, improving the growing stock by proper selection of seed as well as the species to be planted, becomes increasingly important. The old, haphazard use of seed irrespective of its source is now taboo.

(11) Improved agricultural technique brings a gradual retreat of agriculture from poorer soils. This, with the demand for forest products, and the need for protection against shifting sands, hot winds, etc., has created in European countries as well as here a movement to extend forest planting to what have been considered as waste lands.

FOREST INVENTORY COMPLETED

Some five miles north of Tomahawk, Wisconsin, on a snowy day in March, 1937, a group of forest surveyors with appropriate ceremony drove a "golden spike" in a memorial post that marked the end of a long and arduous trail. An inscription on the post, noting the exact location, the occurrence, and the date, left for casual visitors to those northern wilds an arresting record of a memorable event.

It was the last day and the last sample plot of the Lake States Forest Survey that had started three and one-half years before and covered the entire forest area of three states. Begun in Minnesota, October 10, 1933, extended to Michigan and then to Wisconsin, the last survey line was run and final measurement

recorded north of Tomahawk on March 16, 1937.

When the job was done it was computed that no less than 15,600 miles of survey line had been run and accurate data recorded for 125,000 sample plots. The total forest area represented was more than 100 million acres. It is no wonder that Ed L. Lawson, field chief, and the boys who were with him that day caused the woodland to ring with resounding blows upon the railroad spike adorned with gilt paint that served in lieu of the more romantic "golden" variety.

The method used, of course, is so well known in forestry circles as to need no detailed description here. Following the lead of Finland, Sweden, and Norway in their national forest surveys, the line-plot method of survey was adapted to still larger investigations in this country. It consists of running survey lines east and west at regular intervals across the forest area and laying out sample plots at regular points along these lines.

In the Lake States these lines were run across the entire area, state by state, at intervals of 10 miles. Every 40 rods or one-eighth mile along the lines a sample plot of one-fifth acre was established. On these plots the most careful measurements of timber size, density, rate of growth, species of old and new growth, were recorded for analyses of the district, state, and regional forest situations.

Besides the actual forest inventory just completed, many related studies are going on--forest and woodworking industries, labor employment, land ownership and taxation, farm woodlots and shelterbelts. These studies have been largely completed for Minnesota and Michigan. The Wisconsin inventory and other studies are now being analyzed and will be available within the

next few months.

It has been found in Europe and in previous limited surveys in this country that the line-plot method of forest inventory, for large investigations, is remarkably accurate in its results. It has been adopted in most of the regions where the Forest Survey has been going forward. When the regional studies are complete they will be fitted together into a national picture to form the basis for a sound future national forest policy.

NEW DISEASE OF NORWAY PINE

Norway pine has been favored as a species for planting for a number of reasons, one of the most important being its freedom from disease and insect enemies. Now, a fungus disease (Tympanis sp.) is beginning to attack Norway pine plantations. However, recent studies* of the disease indicate that it is not to be feared except when Norway pine is planted outside of its natural range.

The disease has been found in southern Connecticut, and several points in New York, Pennsylvania, New Jersey, and southern Michigan. The most severe infections are those in Connecticut. It should be noted that all these places are southern extensions of the natural range of Norway pine. To date Norway pine has been growing very successfully in these areas, despite the more temperate conditions and greater precipitation.

Climatic factors apparently are connected with the incidence of the disease. A severe drought period occurred in 1930 and this year marked the beginning of 90 percent of the 350 cankers dissected during the course of the study.

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*Hansbrough, John Raymond, "The Tympanis Canker of Red Pine." Bul. No. 43, Yale University. School of Forestry.

The study definitely established the fact that the fungus tends to attack the less vigorous individuals in a stand; the trees in the overtopped crown class were much more subject to attack than the dominant and codominant, although some of the slower growing individuals in these classes were infected.

The damage by the fungus consists of cankers on the main stem of the tree. Only very seldom do these cankers completely girdle the tree and kill it. They do produce such serious defects as to greatly degrade the butt log. In addition, the cankers weaken the stem and make the infected trees liable to breakage. The cankers also afford points of vulnerability for the attack of other rots.

The author of the bulletin describing this new disease feels that the damage caused by the disease will not exceed 10 percent of the expectation value of the crop. The fungus is a weak parasite on Norway pine and only attains the status of a disease when the hosts are weakened in vigor by some environmental complex. This fact, coupled with the present distribution of the disease, largely south of the natural range of Norway pine, makes it appear improbable that it will be a dangerous pest in the Lake States' plantations.

HEAT, DROUGHT OR BOTH?

The summer of 1936 introduced the Lake States region to even more extreme conditions of drought than had been experienced in the past several years. With the drought, new records for sustained high temperature were also established. Both of these factors, drought and heat, are responsible for heavy mortality in plantations, but usually their effects are not determined separately. In a special study made to investigate the damage during

the summer of 1936, the mortality caused by heat was listed separately from that due to drought.

Heat injury was evident in the field by the discolored ring of "cooked" cambium found on the smaller trees, usually within one inch of the soil surface. In a few cases such "dead" trees were found which still had live roots, indicating definitely that drought did not cause death. The heat was not intense enough to girdle larger trees (over one-half inch in diameter at the root collar) but did cause lesions on the southwesterly sides of many such trees which are still living, as well as those which finally succumbed to drought. Previous laboratory tests have shown that 2-hour exposures to temperatures at 135° F. are lethal for 2-2 Norway and white pine stock. Thermograph records taken on the Huron National Forest experimental plots during 1936 showed a new maximum temperature of 175° F. at the soil surface in the open, and one record of 8½ consecutive hours with temperatures above 130° F. This definitely shows that the possibilities of tremendous heat damage were present. Soil moisture samples taken throughout the year also showed that there was sufficient moisture deficiency to bring about death in several localities.

As a result of this diagnosis, heat was found to be the major mortality factor in 1936, with drought second and other causes of little importance. In 10 jack pine plantations, averaging only 2½ years in age from seed, heat caused nearly 74 percent of the mortality, drought 26 percent, and other factors a negligible amount. For 15 Norway pine plantations which average nearly seven years in age from seed, heat caused nearly 58 percent of the loss, drought 41 percent, and other factors 1 percent. The lower heat loss for Norway pine was apparently due to the greater average age of the trees and the slightly more

abundant cover protecting them.

JACK PINE SEED SUPPLY

Seed trap records from several localities in the Lake States over a period of several years have consistently shown that standing jack pine trees yield only a meager seed supply under normal conditions. Other studies have shown that there is a large supply of viable seed locked up in jack pine cones. Moreover, when the cones are brought near the ground, as is the case in slash, where air temperatures become high enough to open them, this large supply of seed is released.

The following table, based on results of cutting experiments on the Huron National Forest in Michigan, presents a specific example showing the comparative amounts of seed released on a clear-cut area, two partially cut areas--on one of which two-thirds of the basal area was removed, and on the other, one-third of the basal area removed--and an uncut area. Obviously the entire seed supply of the clear-cut area is from the slash, on the two partially cut areas it is both from slash and standing trees, and on the uncut areas from standing trees only.

The striking difference between the various conditions represented is readily apparent. There is, of course, a great gulf separating the amount of available seed from the uncut areas as compared with those upon which some slash was available. There is a further large increase from one-third cut to two-thirds cut to clear cutting. The amount of good seed per acre released on the uncut areas is actually less than 1 percent of that released on the clear-cut area. While the percentage of good seed varies from 37-57 for the various conditions, it is exactly 50 for the entire data.

Condition	Number of seed per acre		Percent of good seed
	Total seed	Good seed	
Clear cut	1,046,539	584,537	56
2/3 cut	885,883	379,405	43
1/3 cut	149,765	85,321	57
Uncut	11,670	4,279	37
Total observed*	6,409,942	3,207,694	50

*This is the total number of seed per acre from all seed traps. The values under clear cut, etc., are averages for three or more sub-plots.

This specific example serves again to emphasize the fact that jack pine stands cannot be depended upon to furnish adequate seed for their own regeneration under normal conditions, and that jack pine slash is not merely an element of fire hazard but provides a means for releasing a large stored-up supply of seed for regeneration of the stand.

FOREST SURVEY SHOWS LARGER TIMBER VOLUME IN TWO STATES

Forest Survey statistics recently completed for Minnesota and Michigan show volumes considerably higher than recorded in the Copeland Report. The older estimate of 16,430,000,000 board feet for Michigan has been increased to 28,549,000,000 feet and the Minnesota figure enlarged from 8,580,000,000 to 12,454,740,000 board feet. The present estimates include the volume of scattered timber on cutover lands (all trees 9 inches and larger in diameter) as well as volume in strictly commercial stands. The complete estimate follows:

Standing timber volumes - 1935

Species	Volume in thousand board feet (Lumber tally)	
	Minnesota	Michigan
White pine	1,598,200	1,010,000
Norway pine	998,380	187,000
Jack pine	2,262,790	169,000
Hemlock	-	6,550,000
Balsam fir	350,310	606,000
Spruce	1,240,730	984,000
Tamarack	137,340	78,000
All soft wood	6,587,750	9,584,000
Sugar maple	306,120	7,423,000
Yellow birch	93,230	3,771,000
Beech	-	1,326,000
Basswood	451,200	760,000
Elm	701,690	1,248,000
Oak	761,790	1,211,000
Poplar	2,366,700	955,000
Miscellaneous*	1,186,260	2,271,000
	5,866,990	18,965,000
State Total	12,454,740	28,549,000

*Including paper birch and red maple.

BIGGER STOCK - BETTER SURVIVAL

For several years, the Station has been urging the superiority of the larger sizes of planting stock. With the passing of each field season, more evidence is accumulated to show the advantages of planting large stock. This year, the data comes from the Lake States region proper and from the Plains States.

Results of the long-time planting experiment on the Huron National Forest plainly indicate that the trees which were larger at the time of planting withstood the worst drought year on record in the locality better than the smaller trees. To cite one example among many, Norway pine planted in the fall of 1935

showed the following survival percentages: 1-0 stock, 5%; 2-0 stock, 14%; 1-1 stock, 18%; 2-1 stock, 38%; and 2-2 stock, 59%.

A special mortality study made in the fall on the Huron National Forest lends supporting evidence. The excavation and examination of 5,200 trees showed that it was the smaller trees which suffered the most severe losses during the drought and heat of 1936.

The results of plantations made in the Plains States also attest the advantages of big stock. An experiment was conducted at Mangum, Oklahoma, involving 20,000 seedlings of 14 different species. These seedlings were graded into size classes on the basis of the diameter of the stem at a point 2 inches above the ground line, and on the height of the top.

The field season of 1936 provided a very severe test as rainfall was far below the normal value. The survival of the planted trees was directly proportional to the diameter as measured. For most species, trees under 4/32-inch diameter were culls (5 to 40% survival); those of 5/32 and 6/32 inch were marginal (40 to 75% survival); and trees over 6/32 and up to 16/32 were premium grade (75 to 99% survival). The use of stock larger than the premium grade gave good survival but materially increased the cost of planting.

Once more the advantages of large, vigorous planting stock have been demonstrated under actual field conditions of great severity.

LESS WATERING - GREATER DROUGHT RESISTANCE

Too much coddling appears to produce the same effect in the forest nursery as it does in the family nursery. A recent series of tests of relative drought resistance were conducted in

the special drought machine in which artificial drought conditions are created by control of air temperature and moisture. These tests indicate that nursery stock which has been watered frequently is not so well able to withstand drought as seedlings which have been watered very sparingly.

Two lots of each of three species--jack pine 2-0, white pine 2-0, and Norway pine 2-0--were grown in the Station's greenhouse under identical conditions except that one lot was watered once or sometimes twice daily whereas the other lot was watered only every 2-3 days, even during hot weather. The two lots of seedlings were then placed in the drought machine and run until every plant was dead. The average number of days which each lot lived was then computed and a statistically significant difference in favor of the infrequently watered plants was found. A parallel test was run with stock grown in the Lydick nursery and in the small Experimental Forest nursery, both of which are located at Cass Lake. Watering practice in the Lydick nursery calls for frequent applications whereas in the Experimental nursery water is applied only when absolutely necessary. The less watered stock again proved most drought resistant.

To judge from the appearance of the stock in both tests, drought resistance seems to be correlated directly with root development, which is encouraged by infrequent watering.

At present it is a little difficult to make definite recommendations for watering practices to be followed in large nurseries, since it is not practical to adopt exactly the methods which gave such good results in the greenhouse tests. However, certain procedures which are practical can be suggested. It will probably be best not to withhold watering during the spring, but by July 1 frequent watering should be discontinued and water

should be applied only when it begins to appear absolutely essential. This point will be indicated by the browning of the needle tips or even the death of some of the smaller and weaker plants. Probably in order to prevent too great losses, watering will have to be started in some sections of the nursery sooner than is optimum in order that the sections which receive water last will not have to wait too long.

WHAT ARE FORESTS WORTH FOR FLOOD CONTROL?

The recent serious floods in the Ohio Valley have awakened the public to the unfortunate condition of much of the land surface in this and other regions. Many sources of public information such as newspapers and periodicals have been quick to tack the banner of forest conservation to their mastheads as a cure for these floods. Other, and usually more professional, groups, such as engineering associations, have contended that little can be expected in the way of flood control even though forests were restored to all areas not needed for agriculture.

A recent address given before the Minnesota section of the Society of American Foresters by C. G. Bates of the Experiment Station, explained both sides of this question, and attempted to draw an unbiased conclusion as to just what forests can be expected to do in reducing flood probability and severity.

In attempting to analyze the influence of forests on flood control, it should first be emphasized that not all forested lands are equally effective as storage reservoirs for excessive amounts of precipitation. All types of forest offer roughly equal mechanical barriers to runoff; that is to say, a certain amount of the precipitation will be intercepted by the branches and foliage, and the litter and humus will offer obstacles to the

flowing of surface water and will induct it into the soil. This latter process occurs at an almost unlimited rate under old forest, and it has not been given, even by foresters, half the credit it deserves. But these effects, while most often pointed out, are not more important than the ability of the earth under a forest cover to store large supplies of water which are released subsequently at a relatively gradual and uniform rate. As regards their effectiveness as storage reservoirs, forested watersheds may be divided into three very generalized classes. First is the "unsaturable" type which occurs chiefly on heavy and deep soils underlain by great depths of limestone and other sedimentary materials. If forests on such sites are protected from fire and grazing, they will have water storage capacities which will never be taxed even by the most severe conditions which can be imagined.

The second class of watersheds are those possessing only loose or shallow soil, or both, which absorbs readily enough, but which is underlain by impermeable rocks of metamorphic or igneous origin. Sometimes a layer of impermeable clay will be found under the soil. Such watersheds, often located on mountain slopes, can become saturated and hence are termed "saturable." After prolonged rains such slopes may transport water upon the underlying surfaces of impermeable rock and feed it into stream channels almost as rapidly as the water is absorbed. Sand dunes or glacial mounds are definitely of this class if they do not rise far above the water-table level.

The third class are the areas of poorly drained land which are actually in a "saturated" condition for a good part of the year, especially during the winter season when they are most needed as storage reservoirs. On such areas, the presence or

absence of forests makes very little difference in the amount of water which will be stored. When there is space available, water will be absorbed and when the areas become full, the water will drain off laterally.

The actual storage capacity of forests belonging to the first class, when compared with the cost of equivalent storage in artificial reservoirs, furnishes an estimate of the cash value of the protection afforded by such forests. To take a concrete example, the annual fixed charges and maintenance costs for a large and effective program of reservoir construction in the Ohio Valley have been estimated at $1.15 per acre-foot of storage. Available data indicate that well-managed forests belonging to the first class of "unsaturable" areas can provide close to an acre-foot of storage in any single flood period. At this rate the protective value of an acre of forest land can be considered to equal about $1 per year. In other regions, where no more than 6 inches of rain are likely to fall in any brief period, the storage value of forest land would be only half as much.

In planning for flood control, efforts should be directed towards keeping the forest areas which are most effective for water storage purposes in the best possible condition. The development of cover, through protection from grazing and fire, on land which has never been plowed, will yield returns much more quickly than the planting of worn-out fields and the like. A program of this nature coupled with a program of engineering developments where suitable forest areas do not or can not cover a large proportion of any given drainage, should provide the best permanent flood prevention system that is possible for this country.